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09/931,862	08/20/2001	Hae-Kyoung Kim	249/274	3541

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EXAMINER
DOVE, TRACY MAE

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 10/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No.	Applicant(s)	
	09/931,862	KIM, HAE-KYOUNG	
	Examiner Tracy Dove	Art Unit 1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 18 August 2004.
- 2a) This action is **FINAL**.                            2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) \_\_\_\_\_ is/are allowed.
- 6) Claim(s) 1-23 is/are rejected.
- 7) Claim(s) \_\_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 20 August 2001 is/are: a) accepted or b) objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) All    b) Some \* c) None of:
  1. Certified copies of the priority documents have been received.
  2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: \_\_\_\_\_.

## **DETAILED ACTION**

This Office Action is in response to the communication filed on 8/18/04. Applicant's argument have been considered, but are not persuasive. Claims 1-23 are pending and remain rejected in view of the prior art.

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/23/04 has been entered.

### ***Claim Objections***

Claim 6 is objected to because of the following informalities: in the last line, "bout" should recite "about". Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 6-12 and 15-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Bahar et al., US 5,635,041.

Regarding claims 1-3, Bahar teaches a composite membrane comprising a base material 4 and an ion exchange material/resin 2. The base material is a porous microstructure (porous

support) and the ion exchange resin impregnates the membrane, i.e. base material (col. 3, lines 29-40). The ion exchange material may be comprised of at least in part a powder, such as but not limited to, carbon black, graphite, nickel, silica, titanium dioxide and platinum black (col. 2, lines 58-61). Optionally, the ion exchange materials may be complemented by finely divided powders or other (non-ionic) polymers to provide final composites. Such a finely divided powder may be selected from organic or inorganic compounds such as, but not limited to, carbon black, graphite, nickel, silica ( $\text{SiO}_2$ ), titanium dioxide ( $\text{TiO}_2$ ) or platinum black (catalyst). The powders provide specific added effects such as electrical conductivity, thermal conductivity, catalytic effects and/or enhanced or reduced reactant transport properties (col. 4, line 66-col. 5, line 8). Note silica and titanium dioxide are moisture retentive materials and platinum is a catalyst, as described in the instant specification (page 9, lines 9-21).

Regarding claims 6-7, a preferred base material is expanded polytetrafluoroethylene (ePTFE) having a porosity of greater than 35%, preferably between 70-95% (col. 3, lines 62-67).

Regarding claim 8, suitable ion exchange materials include perfluorinated sulfonic acid resin, perfluorinated carboxylic acid resin, polyvinyl alcohol, divinyl benzene, styrene-based polymers and metal salts with or without a polymer (col. 4, lines 58-63).

Regarding claims 9 and 23, a solution is prepared containing an ion exchange material (and optionally a finely divided powder). The solution may be applied to the base material by any conventional coating technique including roll coating, gravure coating, doctor coating, kiss coating, dipping, brushing, painting or spraying so long as the liquid solution is able to penetrate the interstices and interior volume of the base material (col. 6, lines 19-27).

Regarding claims 10-12 and 15-18, the composite membrane may be used in a fuel cell (claim 4). Ion exchange membranes are used in polymer electrolyte fuel cells as solid electrolytes (col. 1, lines 14-15). The composite membrane of Bahar may be used in various applications, including fuel cells and batteries (col. 3, lines 41-44).

Regarding claims 19-22, a direct methanol fuel cell (DMFC) has the same structure as the polymer electrolyte membrane fuel cell (PEMFC), but uses liquid methanol, instead of hydrogen, as a fuel source (see page 3, lines 13-14 of the instant specification “Description of Related Art). Thus, the direct methanol fuel cell of claim 19 is a polymer electrolyte fuel cell (taught by Bahar). Note that whether methanol or hydrogen is used as the fuel source, the fuel cell is a polymer electrolyte type fuel cell (the terminology of the preamble does not limit the claimed structure MPEP 2111.02 ).

Thus, the claims are anticipated.

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Claims 1, 2, 5-11 and 14-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Grot et al., US 5,919,583.

Regarding claims 1, 2, 6, 7, 10, 11, 15, 16, 19 and 21, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30 wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous

support for improving mechanical properties. The porous support may be a polyolefin (polyethylene or polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Regarding claims 5, 8, 14, 17, 20 and 22, the cation exchange groups of the polymer are selected from the group consisting of sulfonate, carboxylate, phosphonate, imide, sulfonimide and sulfonamide. In a preferred embodiment, highly fluorinated polymer with sulfonate groups is employed (col. 2, lines 39-50). The term "sulfonate groups" is intended to refer either to sulfonic acid groups or alkali metal or ammonium salts of sulfonic acid groups (col. 3, lines 57-60). Example 2 teaches a solution containing a sulfonated perfluorocarbon copolymer having as a perfluorocarbon backbone and side chains  $-\text{O}-\text{CF}_2\text{CF}(\text{CF}_3)-\text{O}-\text{CF}_2\text{CF}_2\text{SO}_3\text{H}$  in hydrogen ion form and which has an equivalent weight of about 1080. Tin mordenite is added to the solution and the solution is poured onto a polytetrafluoroethylene sheet substrate (porous support).

Regarding claims 9, 18 and 23, a solution of an inorganic filler and a polymer ionic form can be used to apply a coating to a porous support to form the membrane (col. 6, lines 42-46). The polymer is distributed through the internal pores of the support (col. 5, lines 32-35) and the inorganic filler is incorporated into the membrane (col. 6, line 40). Thus, the membrane of Grot

is formed by impregnating the porous support with a composition of ion-exchange polymer and the inorganic filler (reinforcing agent).

Thus the claims are anticipated.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 8, 10-13, 17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al., US 5,766,787 in view of Grot et al., US 5,919,583.

Watanabe teaches a solid polymer electrolyte fuel cell comprising a solid polymer electrolyte membrane incorporating 5.8 wt% platinum catalyst and 5 wt% silica in Nafion (perfluorocarbon sulfonic acid cation exchange resin) or 5.8 wt% platinum catalyst and 5 wt% titania ( $TiO_2$ ) in Nafion. See col. 6, lines 40-48 and col. 8, lines 23-64. Thus, the platinum catalyst is about 54 wt% and the silica (or titania) is about 46 wt% of the total amount of catalyst plus metal oxide (reinforcing agent) contained in the polymer electrolyte membrane. The membrane comprises 0.01-80 wt% of at least one metal catalyst (Pt, Au, Pd, Rh, Ir and/or Ru) and 0.01-50wt% of particles and/or fibers of at least one metal oxide (silica, titania and/or zirconia). See col. 3, lines 29-42. Methanol gas and oxygen gas may be used as the reactant gases for the fuel cell (col. 3, lines 57-59).

Watanabe does not explicitly state the polymer electrolyte membrane includes a porous support.

However, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30 wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous support for improving mechanical properties, for decreasing cost and/or other reasons. The porous support may be a polyolefin (polyethylene or polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Therefore, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because one of skill would have been motivated to incorporate a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties and/or decrease the cost of the membrane (see Grot col. 5, lines 1-3). Grot teaches that the polymer electrolyte membranes optionally include a porous support. Therefore, one of skill in the art would be motivated to provide a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties of the

membrane and/or to decrease the cost of the membrane. Grot teaches membranes containing a cation exchange polymer and a reinforcing agent (as defined by the instant specification) may or may not include a porous support. Both Watanabe and Grot teach direct methanol fuel cells.

***Response to Arguments***

Applicant's arguments filed 8/18/04 have been fully considered but they are not persuasive.

**35 U.S.C. 102(b) in view of Bahar**

Applicant argues Bahar fails to disclose a reinforced composite ionic conductive polymer membrane as recited in the present claims because Bahar fails to disclose “a reinforcing agent being different from the ion-exchange polymer”. Applicant states the Bahar, unlike the present invention, discloses an ion exchange polymer that may or may not include additives. The ion exchange polymer materials disclosed by Bahar (perfluorinated sulfonic acid resin, perfluorinated carboxylic acid resin, polyvinyl alcohol, divinyl benzene, styrene-based polymers and metal salts with or without a polymer (col. 4, lines 58-63)) are clearly different materials than the additive materials disclosed by Bahar (carbon black, graphite, nickel, silica (SiO<sub>2</sub>), titanium dioxide (TiO<sub>2</sub>) or platinum black (catalyst)). Thus, Applicant's argument is not convincing.

Applicant argues that superior results have been achieved by the claimed invention. However, unexpected results cannot be used to overcome an anticipation (35 U.S.C. 102(b)) rejection. Furthermore, the comparative examples of the present specification are not representative of the entire teachings of Bahar.

Applicant argues Bahar fails to specifically teach the addition of a “reinforcing agent” in addition to the ion exchange polymer. It is unclear how Applicant reaches this conclusion. The reference clearly discloses additives (reinforcing agents) may be used in addition to the ion exchange polymer. Bahar teaches the ion exchange material may be comprised of at least in part a powder, such as but not limited to, carbon black, graphite, nickel, silica, titanium dioxide and platinum black (col. 2, lines 58-61). Optionally, the ion exchange materials may be complemented by finely divided powders or other (non-ionic) polymers to provide final composites. Such a finely divided powder may be selected from organic or inorganic compounds such as, but not limited to, carbon black, graphite, nickel, silica ( $\text{SiO}_2$ ), titanium dioxide ( $\text{TiO}_2$ ) or platinum black (catalyst). The powders provide specific added effects such as electrical conductivity, thermal conductivity, catalytic effects and/or enhanced or reduced reactant transport properties (col. 4, line 66-col. 5, line 8).

Applicant argues since the additives of Bahar are incorporated into the ion exchange polymer, the additives are not believed to be available as a reactant to reinforce the membrane and provide moisture retentive effects. Examiner requests that Applicant provide the column and line where Bahar recites the above assertion. Bahar clearly teaches the claimed invention, see the 35 U.S.C. 102(b) rejection above.

Applicant argues the examples of Bahar do not employ the disclosed powders added to the polymer. However, Bahar is not limited to the specific examples disclosed. Bahar teaches the claimed invention, see col. 4, lines 58-col. 5, lines 14. Ion exchange materials may be complemented by finely divided powders (silica, titanium dioxide, platinum) to provide final composites. Both Bahar and the claimed invention teach a reinforced composite ionic

conductive polymer membrane. Note Bahar teaches the composite may be formed using a slurry of the ion exchange material (and optionally the powder) in a solvent (col. 6, lines 19-39).

Examiner points out that the Examples of the present specification do not illustrate the superior results achieved when a different reinforcing agent is used together with the ion-exchange polymer. The Examples and Bahar both teach a slurry (mixed reinforcing agent and polymer). Bahar specifically discloses the addition of the claimed reinforcing agent.

35 U.S.C. 102(b) in view of Grot

Applicant argues, like Bahar, Grot fails to disclose the use of a reinforcing agent that is different from the ion-exchange polymer because Grot merely describes conventional fillers and additives incorporated into polymers. Applicant states “incorporating these fillers and additives into the ion-exchange polymer is not the same as adding a reinforcing agent as a different component of the composite ionic conductive polymer”. However, this statement is not commensurate in scope with the claimed invention and it is unclear how Applicant reaches this conclusion regarding the teaching of Grot. At least claim 9 teaches the membrane is formed by impregnating the porous support with a slurry of the ion-exchange polymer and the reinforcing agent. Thus, the reinforcing agent is not incorporated into the membrane at a different time than the ion exchange polymer. Furthermore, Grot teaches the inorganic proton conductor material fills the holes or interstices in the membrane (10:43-54). Applicant states the Examples of the present specification teach a separately added reinforcing agent. This is incorrect. The Examples teach “A Nafion dispersion solution for perfluorinated membranes and silica were mixed thoroughly for 2 hours with application of ultrasonic waves, and ethanol was added to the mixture to obtain a reinforced membrane slurry. The microporous PTFE support was soaked in

the reinforced membrane slurry for 2-3 hours and dried...to form a reinforced composite ionic conductive polymer membrane" (see Example 1). Therefore, the examples do not teach the reinforcing agent is "separately added" as asserted by Applicant.

Applicant states that "mixed thoroughly" does not mean the reinforcing agent is "incorporated" into the ion exchange polymer. However, the references do not recite the additive/fillers are "incorporated" into the ion exchange polymer. Furthermore, the "slurry" of the present invention is the polymer/reinforcing agent with a solvent. Applicant asserts that the reinforcing agent of the prior art becomes part of the polymer. Examiner requests that Applicant point out where each cited prior art reference teaches the reinforcing agent of the prior art becomes part of the polymer.

35 U.S.C. 103(a) over Watanabe in view of Grot

Applicant argues neither Watanabe nor Grot teaches adding a different reinforcing agent that impregnates the porous support as recited in the present claims. Applicant applies the same argument used to argue the anticipation rejections of Bahar and Grot. Examiner has already addressed this argument (see above).

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is 571-272-1285. The examiner can normally be reached on Monday-Thursday (9:00-7:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pat Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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September 30, 2004